Organization: Harvard University

MTO Simbiosys

Title: Nanopore Sensors: Detectors for Analyzing Bio-Molecular Systems

Start Date: July 2001 **End Date:** July 2004

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Project Goals

The goal of this program is to develop solid state nanopore detectors capable of detecting and characterizing single molecules of DNA via tunneling electron spectroscopy of single molecules translocating through the solid state nanopore. This device will be able to rapidly sequence individual DNA molecules and aid in the rapid and detailed identification and characterization of bio-warfare related pathogens.

Technical Approach

The program stresses experimental realization of the nanopore detector articulated with nanoscale metallic electrodes, modeling of polymer translocation in nanopores, materials science modeling of solid state nanopore formation and geometry, and developing signal processing algorithms and strategies for optimal utilization of electronic signals for molecule identification.

Recent Accomplishments

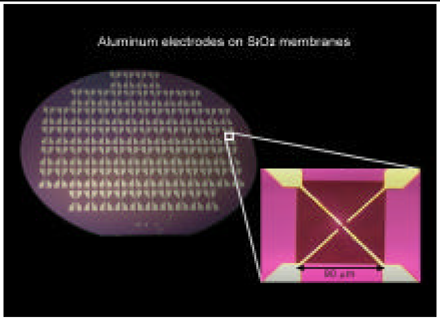
- Nanopore windows prepared on 4" wafers with lithography based electrical access to solid state biopores.
- Biomolecule signals obtained from solid state biospores.
- Nanogap electrodes fashioned on SiO_2membranes by e-beam lithography. Electrically characterized.
- Electrode gap reduction by ion sculpting demonstrated for first time.
- First de-noising and wavelet analysis performed on nanopore data.
- First molecular dynamics calculations for polymer translocating through nanopores.

Six-Month Milestones

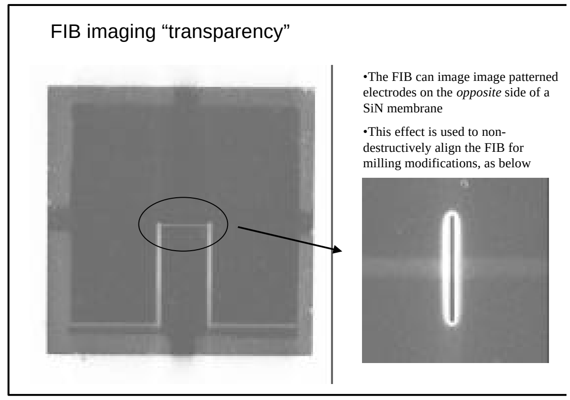
- Nanopore sculpting for tunneling. Demonstrate 2 nm tunneling electrode gap.
- Recognition and Translocation in Nanopore: Formal Proof that DNA molecules translocate through DNA pores.
- Signal Processing: Distinguish translocation events form other events.
- Biopolymer Physics and Brownian Dynamics: Benchmark model parameters using available data.

Team Member Organizations

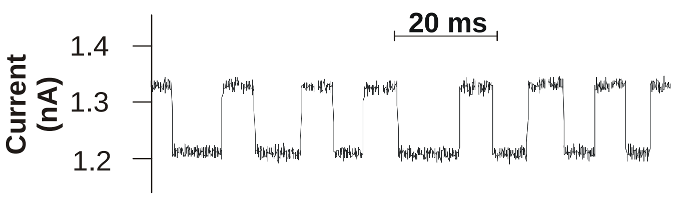
Murugappen Muthukumar, University of Massachusetts



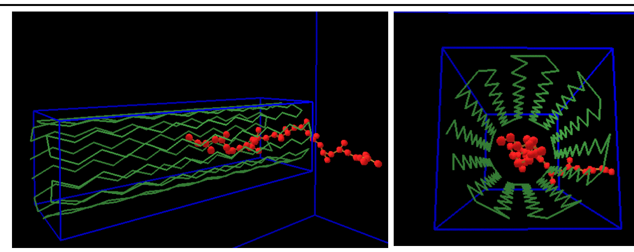
Four inch wafer with 72 solid state nanopore devices articulated with metallic electrical access by optical lithography.



Left Panel. 100 Nanometer wire traversing micron size electrodes. Right Panel. FIB fabricated electrode gap.



Current blockades produced by translocation of a 2,868 bp long dsDNA fragment through a *ca.* 5nm hole in a silicon nitride membrane.



Visualization of Molecular Dynamics simulation of polymer translocating through a nanotube.